

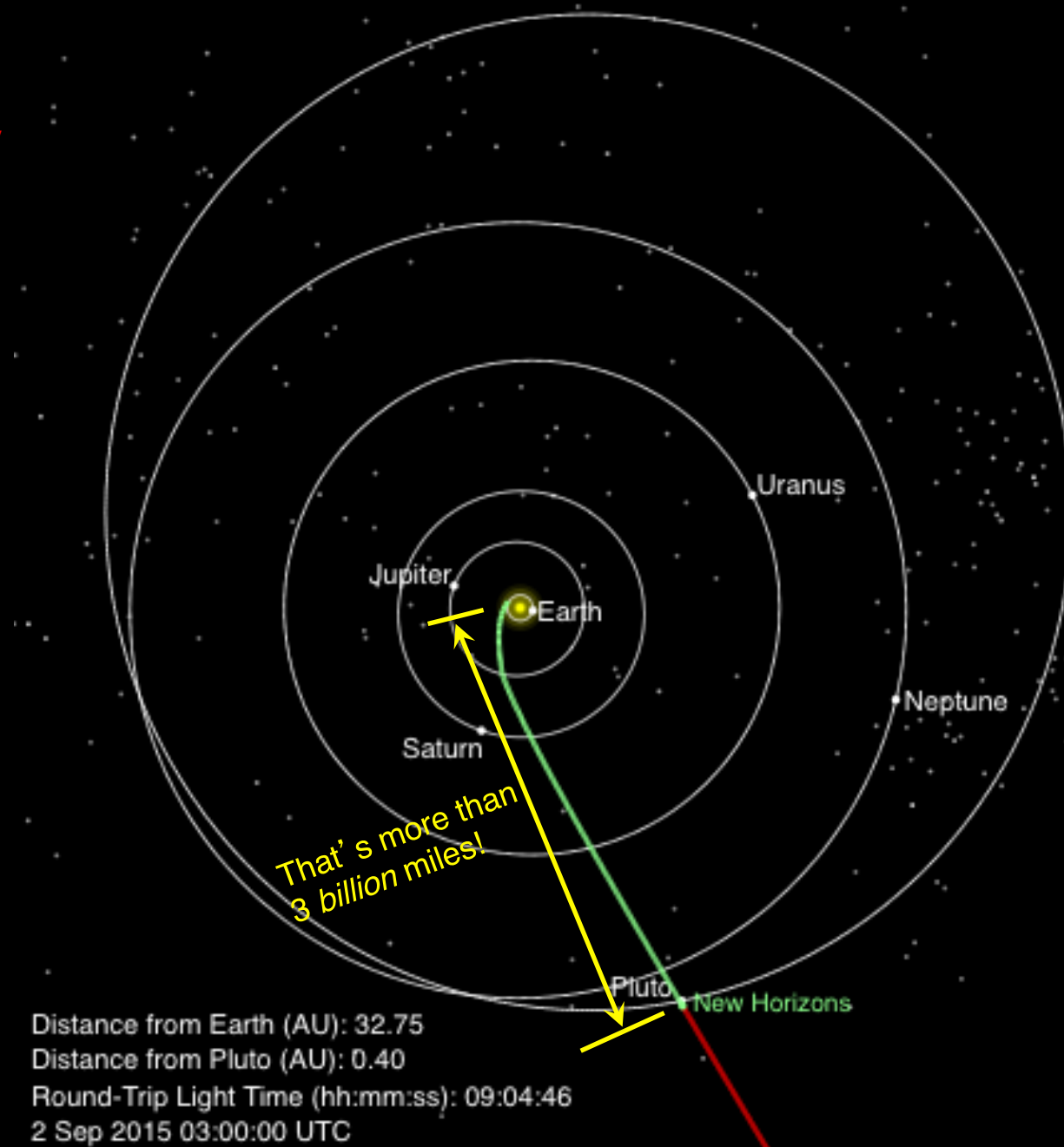
Why Couldn't the *New Horizons* Spacecraft Go Into Orbit at Pluto?

Tom Spilker explains why

New Horizons Full Trajectory - Overhead View

Distance from Sun (AU): 33.32 Heliocentric Velocity (km/s): 14.49

New Horizons
had a long way
to go!



Graphic courtesy of Applied
Physics Laboratory / Johns
Hopkins University

From launch it took New Horizons 9 years, 5 months and 25 days to get there. That's 83,116 hours.

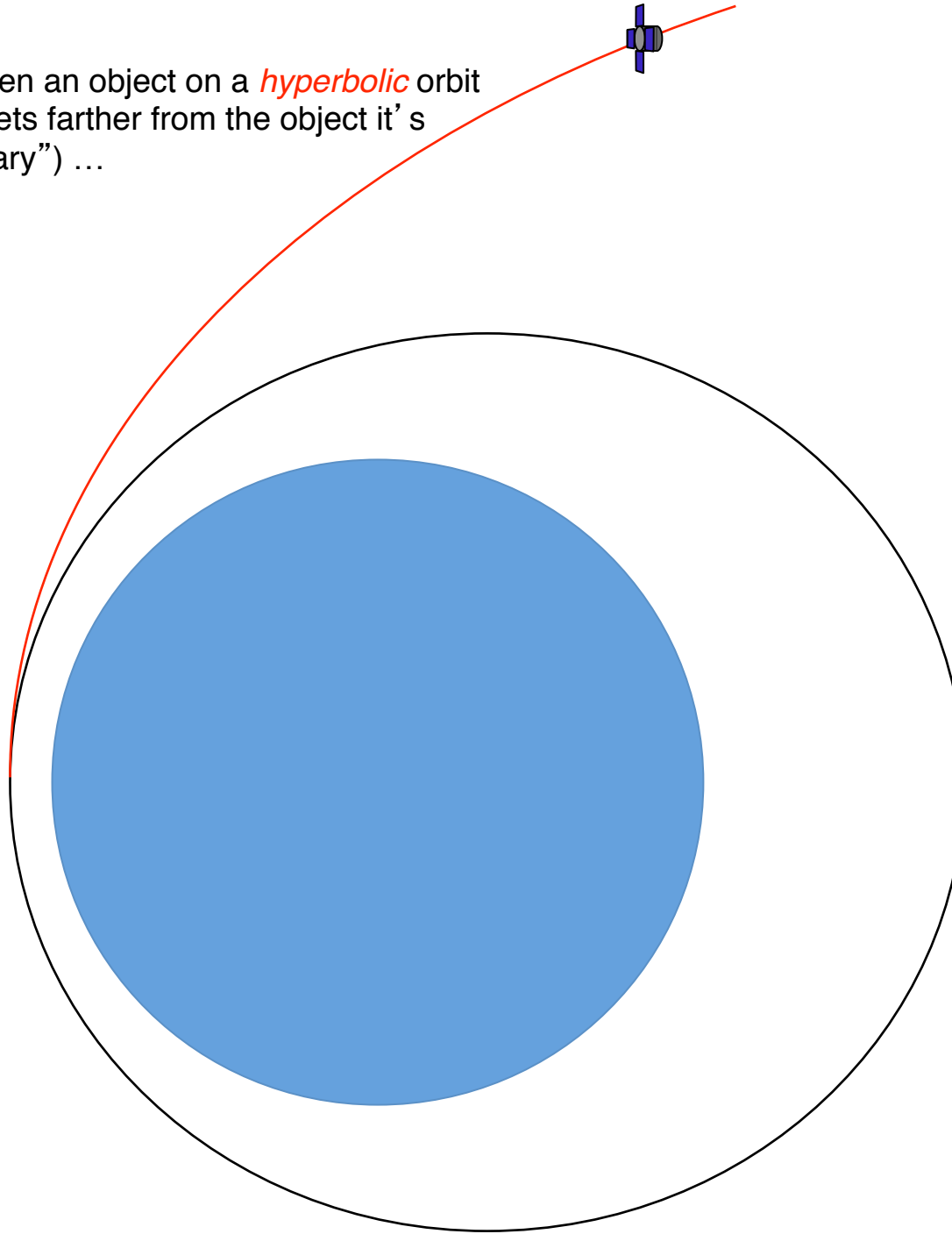
To find the average speed needed to do that, just divide the distance, ~3.1 *billion* miles, by the number of hours, and you get:

$$\text{Average speed} = \sim 37,300 \text{ MPH}$$

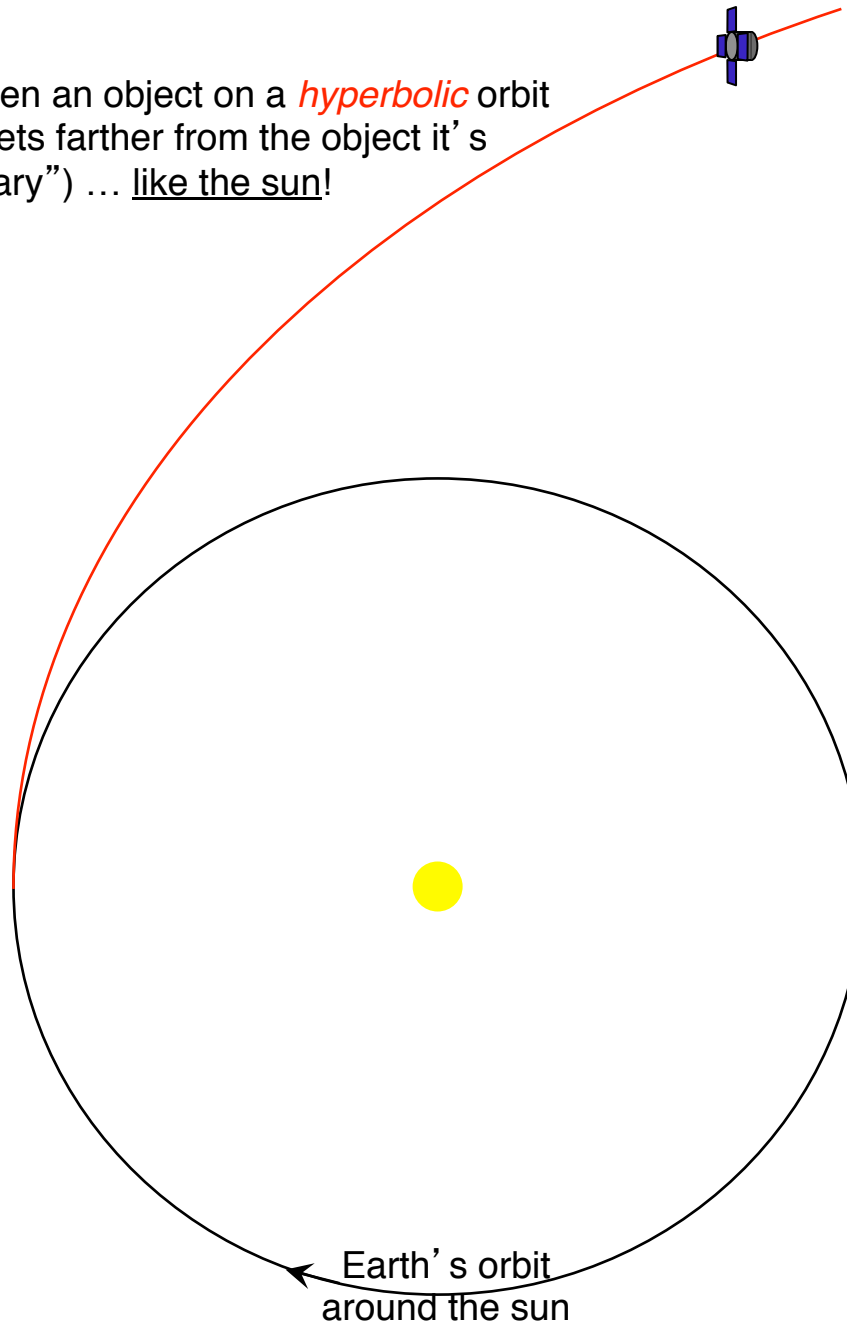
If New Horizons had gone directly from Earth to Pluto, when it left Earth it would have to have been going more than 106,000 MPH with respect to the sun to make that average speed.

Why is that???

Remember that even an object on a *hyperbolic* orbit slows down as it gets farther from the object it's orbiting (the "primary") ...

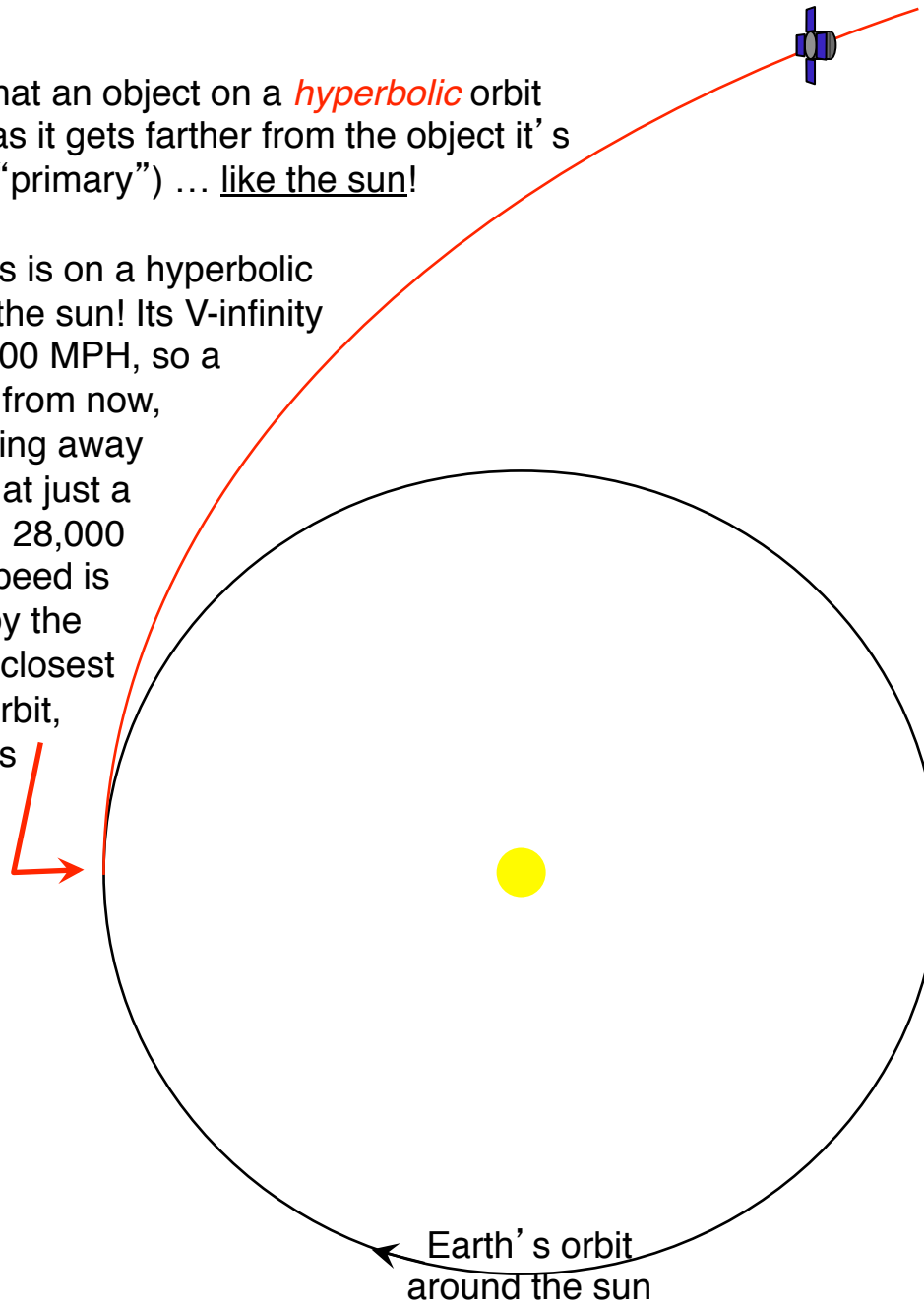


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New Horizons is on a hyperbolic orbit around the sun! Its V-infinity is about 28,000 MPH, so a million years from now, it will be moving away from the sun at just a bit more than 28,000 MPH. That speed is determined by the speed at the closest point of the orbit, and the sun's gravity.

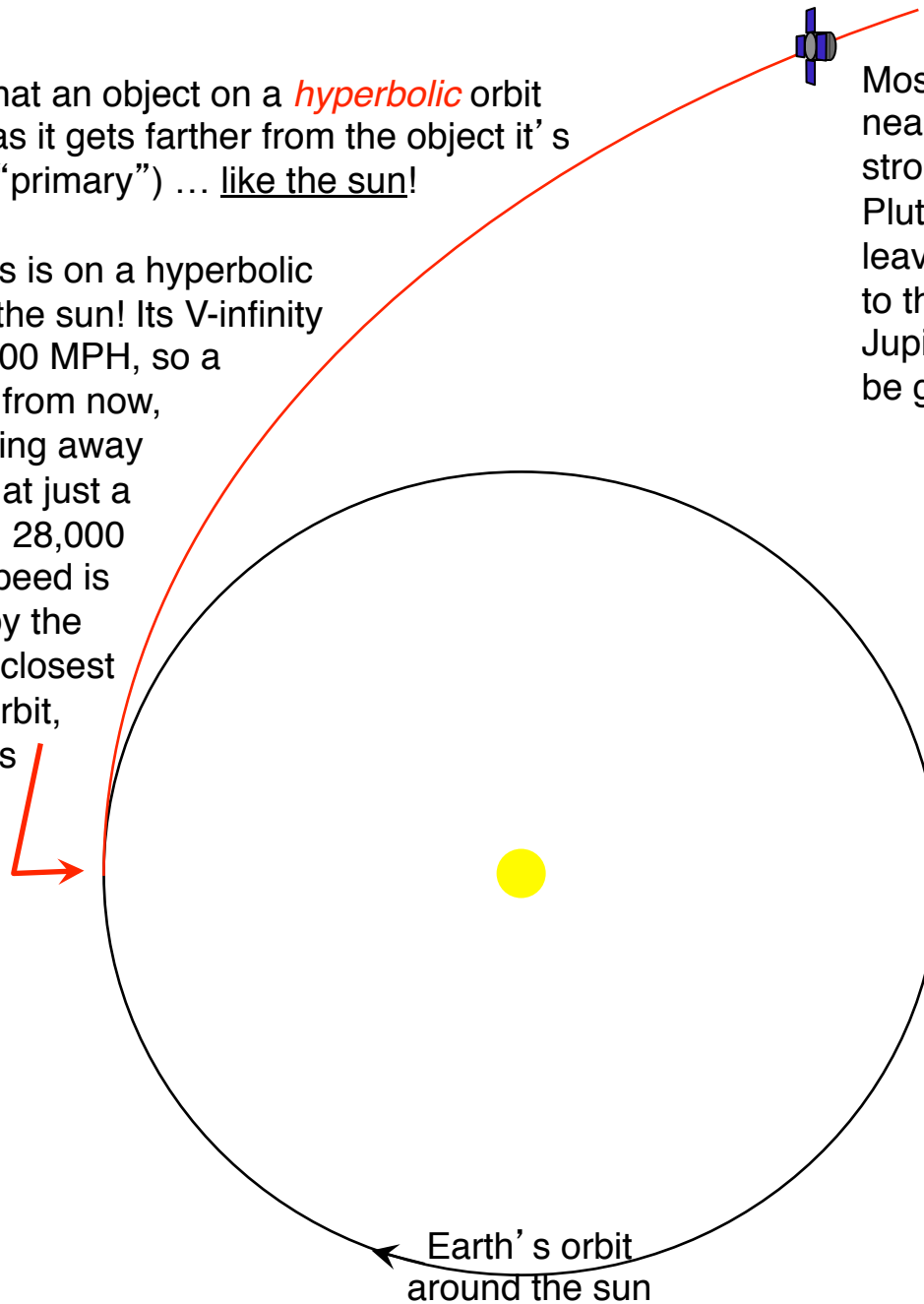


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Most of the slowing down is done when nearest the primary, where its gravity is the strongest. On this imaginary *direct* trip to Pluto (without a boost from Jupiter), after leaving Earth at 106,000 MPH with respect to the sun*, when New Horizons neared Jupiter's distance from the sun, it would be going only ~43,000 MPH.

* 39,300 MPH with respect to Earth, which orbits the sun at an average speed of 66,700 MPH



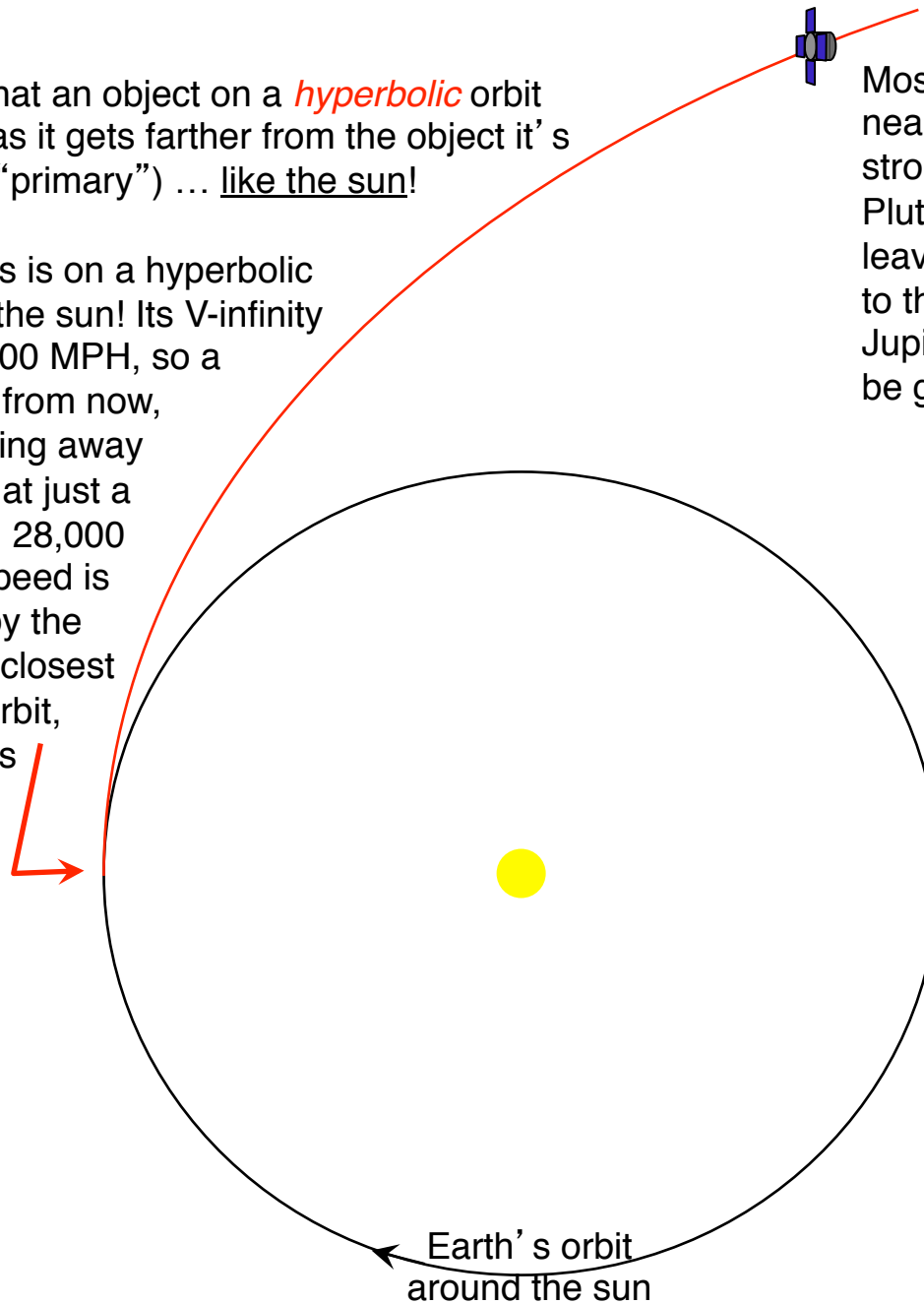
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When it got to Pluto, it would be going only ~32,000 MPH, for an average of 37,300 MPH.



But New Horizons didn't go directly to Pluto. Instead, it flew by Jupiter and used Jupiter's gravity to get a bit of a boost. So at launch the rocket had to add only 36,400 MPH, getting it up to a bit more than 103,000 MPH with respect to the sun. Jupiter's gravity made up the rest.

The current-technology Atlas V 551 rocket, with the two upper stages needed to boost the 1,054 pound New Horizons spacecraft to that speed, weighed

1,315,000 pounds!

That's 1,250 times as much as New Horizons itself!

When New Horizons arrived at Pluto, it was going 30,870 MPH with respect to Pluto. To go into orbit, it would have to slow down by ~28,700 MPH ... otherwise it would just fly on past Pluto, on a hyperbolic orbit that never returns.

A current-technology rocket that could slow New Horizons by that much would weigh ~338,000 pounds. So we would have to send New Horizons *plus that rocket* to Pluto. That adds up to a total of ~339,000 pounds to be sent to Pluto.

A current-technology rocket needed to send 339,000 pounds to Pluto would weigh

422 million pounds!

That's *69 times* as big as the Saturn V, the largest rocket the US ever launched.

And *that's* why New Horizons can't orbit Pluto!

But people are studying new technologies and new approaches that might make a Pluto orbiter mission feasible in the future.

Stay tuned!